



Outbreak of an emerging cocoa pest *Pseudotheraptus devastans* Distant (Heteroptera: Coreidae) in the Haut-Sassandra Central-West of Côte d'Ivoire

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ABSTRACT

Objectives: The stink bug *Pseudotheraptus devastans* causes damage to cocoa plantations in Côte d'Ivoire. This damage reduces farmers' production. This study was conducted to determine periods of high infestation of these stink bugs in the Haut-Sassandra central-western region of Côte d'Ivoire.

Methodology and Results: The infestation of these stink bugs was assessed by sampling using the knock down technique. This technique consisted in spreading sheets of 16 m² in cocoa trees infested by the *P. devastans* bug. The cocoa trees infested were treated with a high dose of a registered insecticide. Dead *P. devastans* bugs were counted on the sheets 5 hours after treatment. The results revealed the presence of *P. devastans* in the cocoa plantations of Haut-Sassandra. These pests represented on average 6.35 ± 0.28 , 5.65 ± 0.07 and 5.10 ± 0.17 for 12 cocoa trees in Zoukougbeu, Gonaté, and Boguedia. The *P. devastans* population curve from 2022 to 2024 revealed that these pests are significant in March, April, August, and September of each year.

Conclusion and application of results: This study has determined the importance of *P. devastans* in cocoa plantations in the Haut-Sassandra region. The population explosion of *Pseudotheraptus devastans* in the Haut-Sassandra region of central-western Côte d'Ivoire will allow for recommendations regarding phytosanitary treatments. Treatments applied to cocoa plantations during July–August and December–January effectively controls this pest in Haut-Sassandra.

Keyword : Bug, *Pseudotheraptus devastans*, Cocoa tree, Côte d'Ivoire.

INTRODUCTION

The stink bug *Pseudotheraptus devastans* (Figure 1) is a pest that damages crop in West Africa (Mariau, 1969). It is found on food crops, industrial crops, and wild plants (Yeboue *et al.*, 2015). Damage caused by *P. devastans* to coconut palms can reduce production by 50 to 80% (Mariau *et al.*, 1981; Koffi *et al.*, 2025). Since 2017, damage caused

by *P. devastans* in cocoa plantations in the Haut-Sassandra region has become significant. In fact, this stink bug is present in all cocoa-producing regions of Côte d'Ivoire (Kouamé *et al.*, 2021). The larvae and adults of *P. devastans* feed on young fruits (cherelles), pods, and suckers (Figure 2). Damage from these pests has also been observed on the

tender aerial parts of the cocoa tree. The feeding punctures of *P. devastans* cause significant deformation of the pods and the beans inside. This damage leads to a massive reduction in yields because the beans in these pods are unusable (Lodos, 1965). The feeding lesions caused by *P. devastans* are similar to those of mirids, but those caused by *P. devastans* are more extensive on the pods (Lodos, 1965). On young shoots, feeding can lead to desiccation and withering, resulting in plant mortality. The wounds caused by feeding punctures on the cacao tree's organs are then

invaded by microorganisms such as pathogenic fungi, causing wilting and mortality (Yebooue *et al.*, 2015; Doh *et al.*, 2016). Today, the fight against these pests is based on the same schedule used for mirids. In Côte d'Ivoire, treatment against mirids and other cocoa pests takes place during July-August and December-January. Chemical control is the primary method used to combat these pests. Today, to ensure good productivity in Ivorian cocoa farming, it is essential to effectively control these pests.



Figure 1: Larva and adult of *Pseudotheraptus devastans*



Figure 2: Damage caused by *Pseudotheraptus devastans* to cocoa pods

At what time of year are *P. devastans* found in cocoa orchards in the Haut-Sassandra region? Specifically, the objectives are to:

- establish the prevalence of this bug in the cocoa plantations of Haut-Sassandra,

- determine the population density of *P. devastans* in the cocoa orchards of Haut-Sassandra.

MATERIALS AND METHODS

Study area: The study was conducted from 2022 to 2024 in the Haut-Sassandra region of central-western Côte d'Ivoire. This region is covered in dense, semi-deciduous rainforest. Logging and agriculture have historically been the main activities in the area. The region's forests have been destroyed to make way for commercial and industrial plantations such as cocoa, coffee, rubber, oil palm, and cashew (Guillaumet and Adjanooun, 1971). The climate is tropical humid, with average annual rainfall between 1200 mm and 1600 mm (Kouamé *et al.*, 2015) and an average annual temperature of 26°C (Guillaumet and Adjanooun, 1971; Tra Bi *et al.*, 2015). There are four seasons: two rainy seasons and two dry seasons. A major rainy season begins in March and ends in July, with peak rainfall in June. A minor rainy season occurs from September to November. A major dry season begins in December and ends in March, and finally, a minor dry season takes place in August (Yao *et al.*, 2013).

Sampling method: The study was conducted in cocoa plantations in the Haut-Sassandra region. The localities of Zoukougbeu, Gonaté, and Boguedia were sampled. To assess the prevalence of *P. devastans*, a survey was carried out in the cocoa plantations of Haut-Sassandra. In Zoukougbeu, Gonaté, and Boguedia, six villages were visited per locality. In each village, three plots were sampled. Regarding the study of the seasonal variation of *P. devastans*, two observation points were selected in each locality. These observation points consisted of several blocks of cocoa plantations. In total, six blocks of cocoa plantations, comprising plantations

belonging to several producers, were selected in the region. The level of *P. devastans* infestation in the cocoa plantations was assessed monthly. Treatments were carried out during the second week of each month.

Insect collection: To collect the *P. devastans* stink bugs, 16 m² (4 x 4 m) white percale tarp were used. This technique consisted of spreading 16 m² white percale tarp directly over the cocoa trees. The identified and covered cocoa trees were treated with a high dose of an approved insecticide. This treatment involved causing all the insects on a single cocoa tree to fall onto the tarpaulin. During this study, 12 cocoa trees containing *P. devastans* stink bugs or their infestations were identified at each observation point during each treatment. The insecticide used contained acetamiprid (20 g/l) and bifenthrin (20 g/l) as active ingredients. This insecticide was used at a concentration of 25 ml per liter of water to kill all the insects hosted by a covered cocoa tree. The treatments were carried out early in the morning between 6:00 and 8:00 a.m.

Bedbug count: The count of dead *P. devastans* stink bugs on the tarpaulins took place 5 hours after insecticide treatment. Before collection, the tarpaulin-covered cacao trees were shaken to dislodge any dead *P. devastans* insects trapped in the foliage. The stink bugs were collected using soft entomological forceps, placed in Petri dishes, and then counted directly on the tarpaulins. The number of stink bugs was determined per tree. The stink bugs were then sent to the laboratory.

Data analysis: The collected data were subjected to analysis of variance using the SAS

General Linear Model to compare bedbug populations from different regions. Mean separation was performed using the Student-

Newman-Keuls test at a significance level of 5%.

RESULTS

Importance of *P. devastans* in the Haut-Sassandra region: The different larval and adult stages of *P. devastans* were collected during this study. The *P. devastans* population did not differ from one location to another. The average number of *P. devastans* per 12 cocoa

trees ranged from 5.10 ± 0.17 to 6.35 ± 0.28 . Zougougbeu recorded 6.35 ± 0.28 *P. devastans* per 12 cocoa trees, followed by Gonaté with 5.65 ± 0.07 *P. devastans* per 12 cocoa trees and Boguedia with 5.10 ± 0.17 *P. devastans* per cocoa trees (Table 1).

Table 1: Presence of *P. devastans* in the Haut-Sassandra region

Locality	Average number of <i>P. devastans</i> / 12 cocoa trees
Zoukougbeu	6.35 ± 0.28 a
Gonaté	5.65 ± 0.07 a
Boguedia	5.10 ± 0.17 a
P	0.0954

Means followed by the same letter are statistically identical at the 5% level (Student-Newman-Keuls).

Importance per year: From 2022 to 2024, monthly data on *P. devastans* were collected. In 2022, the average number of *P. devastans* per 12 cocoa trees was 7.90 ± 0.75 . This

number decreased in 2023 to 5.74 ± 0.05 *P. devastans* per 12 cocoa trees. In 2024, there were fewer than 3.46 ± 0.02 *P. devastans* per 12 cocoa trees (Table 2).

Table 2: Average number of *P. devastans* per year

Year	Average number of <i>P. devastans</i> / 12 cocoa trees
2022	7.90 ± 0.75 a
2023	5.74 ± 0.05 ab
2024	3.46 ± 0.02 b
P	0.0012

Means followed by the same letter are statistically identical at the 5% level (Student-Newman-Keuls).

Seasonal variation of *P. devastans* in the Haut-Sassandra region: The seasonal variation of *P. devastans* showed that these insects are prevalent during the months of March, April, August, September, October, and November. Analysis of *P. devastans* population curves in the localities of Gonaté, Boguedia, and Zoukougbeu revealed a significant presence of *P. devastans* in 2022. This presence was observed throughout the year, with peak numbers in March, August, and November 2022. These pests were also

present in plantations in the Haut-Sassandra region in March 2023 in Boguedia and Zoukougbeu, May 2023 in Boguedia, and August, September, November, and December 2023 in Zoukougbeu, Gonaté, and Boguedia. In 2024, these insects were collected in March and April in Zoukougbeu, Gonaté, and Boguedia. The pests were found in August 2024 in Zoukougbeu and November 2024 in Boguedia with 1 *P. devastans* for 12 cocoa trees per locality (Figure 3).

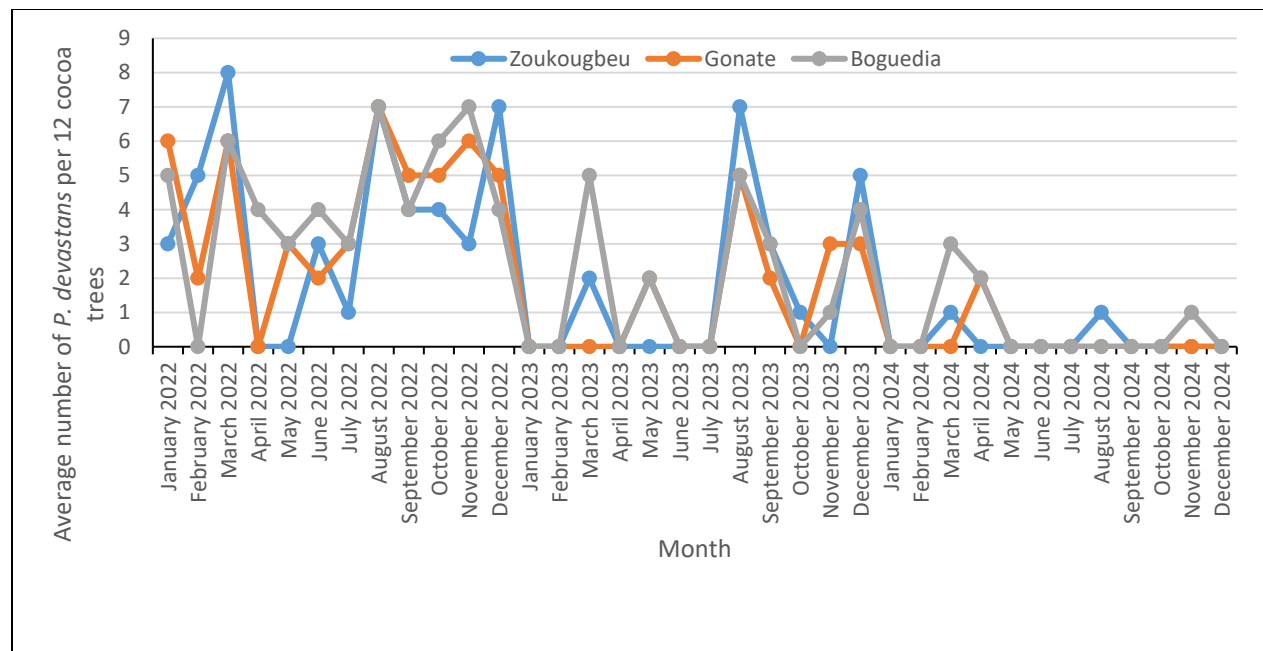


Figure 3: Seasonal variation of *P. devastans* in the localities of the Haut-Sassandra region

Annual variation of *P. devastans* in the Haut-Sassandra region as a function of rainfall: The seasonal variation of *P. devastans* in relation to rainfall showed that these pests were significant in March 2022, April 2022, August 2022, September 2022, and October 2022. Rainfall in March 2022, April 2022, August 2022, September 2022, and October 2022 was good. *P. devastans* was present in March 2023, May 2023, August 2023, and September 2023. During these months, rainfall was good. In 2024, the presence of *P. devastans* was minimal. The highest number of *P. devastans* collected was in March 2024 and April 2024, with an average

of 1.33 *P. devastans* per 12 cocoa trees. These months had average rainfall of 138.68 mm and 66.28 mm. Analysis of the *P. devastans* population curve as a function of rainfall showed that in January 2022, February 2022, November 2022, and December 2022, the average *P. devastans* population per 12 cacao trees was 4.66, 2.33, 5.33, and 5.33, respectively. During these months, average rainfall was 0 mm, 12.95 mm, 14.73 mm, and 24.65 mm (Figure 4). In November 2023, December 2023, and November 2024, the number of *P. devastans* per 12 cocoa trees ranged from 0.33 to 4 (Figure 4).

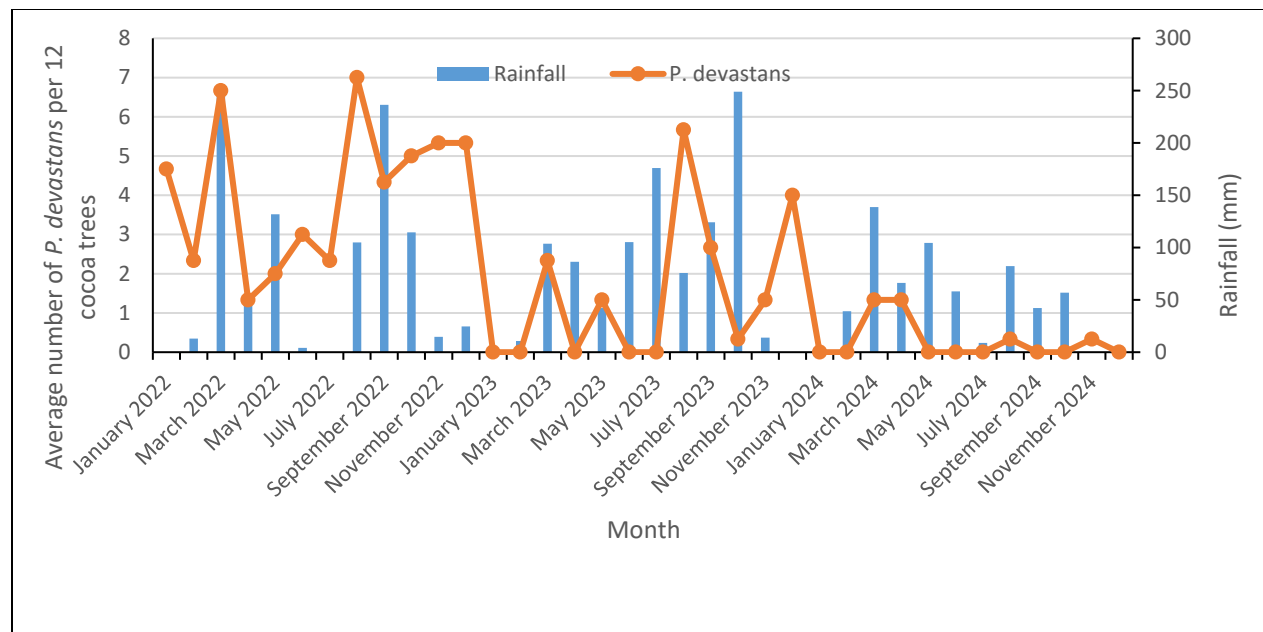


Figure 4: Average seasonal variation of *P. devastans* in the Haut-Sassandra region based on rainfall

Annual variation of *P. devastans* in the Haut-Sassandra region as a function of temperature: The seasonal variation of *P. devastans* as a function of temperature showed that in January 2022 and February 2022, 4.66 and 2.33 *P. devastans* were recorded for 12 cacao trees, respectively. During these months, the average temperatures were 28.4°C and 29.4°C. In January 2023, February 2023, January 2024, and February 2024, the average temperatures were 27.6°C, 28.8°C, 28.6°C,

and 30.3°C, respectively. These months have had 0 *P. devastans*. August had the lowest temperatures. In August 2022, August 2023, and August 2024, the average temperatures were 25.2°C, 25.9°C, and 25.1°C, respectively. During these months, 7 *P. devastans* were recorded. 5.66 and 0.33 *P. devastans* for 12 cocoa trees (Figure 5). In December 2022 and December 2023, the *P. devastans* populations were 5.33 and 4 for 12 cocoa trees.

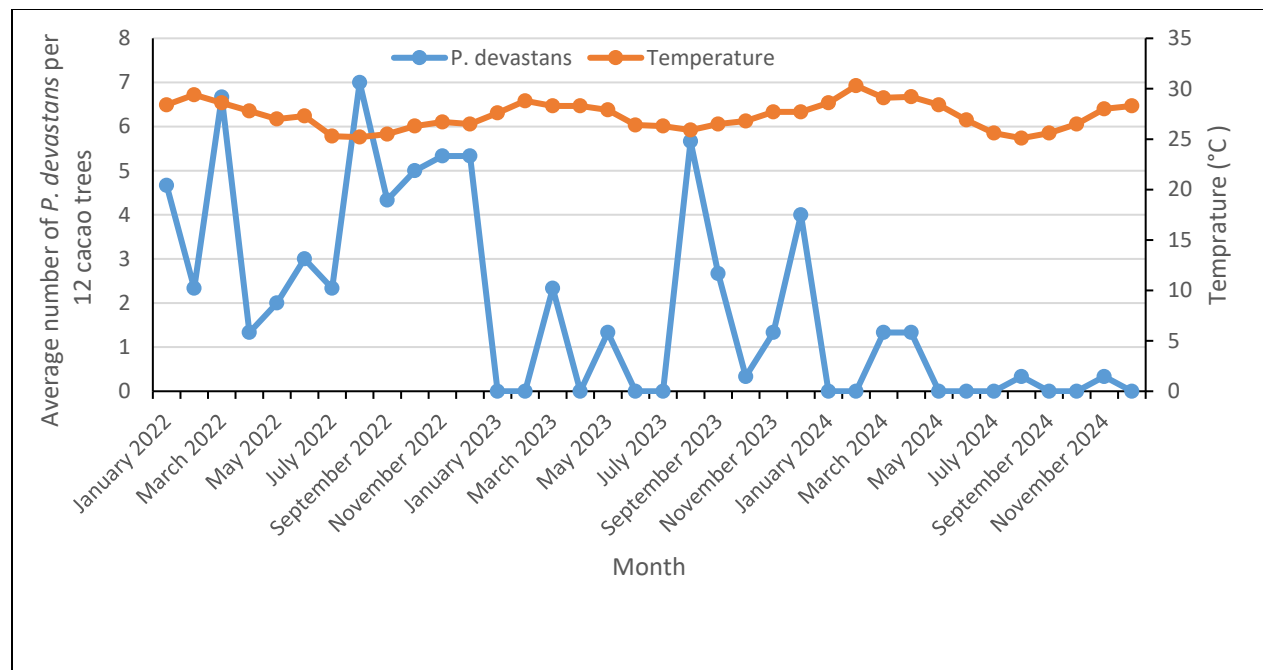


Figure 5: Average seasonal variation of *P. devastans* in the Haut-Sassandra region according to temperature

DISCUSSION

P. devastans was found in all three locations where the study was conducted: Zoukougbeu Gonaté and Boguedia. These pests were collected from all the cocoa plots visited, which is why Logos (1967) stated that *P. devastans* had been present in West African cocoa plantations since the 1960s. The average number of *P. devastans* per 12 cocoa trees ranged from 5.10 ± 0.17 to 6.35 ± 0.28 . Its presence in the Haut-Sassandra region can be explained by the conditions conducive to cocoa cultivation in the area. This presence was also reported by Kouamé *et al.* (2021). According to these authors, this species was even present throughout the cocoa plantations of Côte d'Ivoire. These authors also showed that *P. devastans* had a large population in the Sassandra-Marahoué district, which includes the Haut-Sassandra region. The presence of these pests could also be explained by farmers' lack of awareness. In Côte d'Ivoire, insecticide treatments are reportedly based on the proliferation of cocoa mirids, which are considered the major pests (Kouamé *et al.*,

2021). To better control mirids and other cocoa pests, four treatments were proposed: two in July-August and two in December-January. These applications were to be spaced 28 days apart. Failure by farmers to adhere to these insecticide application periods could encourage the proliferation of unmonitored pests such as *P. devastans*. The significant number of these pests in the region's cocoa plantations is attributed to the presence of cocoa fruit in the area. Indeed, *P. devastans* feeds on cocoa pods, causing significant deformation. This damage leads to decreased yields (Awudzi *et al.*, 2024). This pest is found in cocoa plantations in West Africa and was considered a major problem in the 1960s (Lodos 1967, Fokunang *et al.*, 2004). This presence is attributed to the year-round availability of cocoa pods on the region's cocoa trees. This abundance provides unlimited feeding sites for the pest. However, according to Doh *et al.* (2014), *P. devastans* has three main hosts: cassava, cocoa, and coconut. Therefore, the presence of these three plants in

the same environment could promote the proliferation of this pest. Coreidae *P. devastans* were collected during the three years of the study. In 2022, the average number was 7.90 ± 0.75 per 12 cocoa trees. This number was 5.74 ± 0.05 per 12 cocoa trees and 3.46 ± 0.02 per 12 cocoa trees in 2023 and 2024, respectively. The decreasing number could be explained by the use of insecticide treatments in the region due to the attractive farmgate price of cocoa. This is why Kouamé *et al.* (2015) stated that insecticide treatments remained the primary means of controlling insecticides and other cocoa pests. In Ivorian cocoa production, insecticide treatments were reportedly applied four times a year. Two applications were conducted in July-August and two more in December-January, with a 28-day interval (N'Guessan and Coulibaly, 2000). These applications would also control the Coreidae pest *P. devastans*. The three-year study identified periods of high population explosions of Coreidae *P. devastans* in cocoa plantations in the Haut-Sassandra region. The study of seasonal variations in *P. devastans* populations in the Haut-Sassandra region aimed to propose an effective treatment period against these pests. Monthly variations in *P. devastans* populations revealed two periods of high population explosion in the Haut-Sassandra region. These periods extend from January to June, with population peaks in March, and from July to December, with

population peaks in August each year. These results corroborate those of Awudzi *et al.* (2024) who had stated that the fluctuation of *P. devastans* populations in the cocoa plantation is due to the existence of two periods. One period from January to June with a peak in April and another from July to December with a peak in August. These periods precede cocoa production. Indeed, the cocoa tree is said to have two harvest periods. A major harvest period from September to January and a minor one from May to July (IRCC/CIRAD, 1989). These periods precede the months of *P. devastans* population explosion because these months correspond to the presence of ripening cocoa pods on the trees, and therefore, a food source. In 2022, two relatively brief periods of rainfall were recorded during the year, which could explain the presence of these two periods of population explosion. However, in 2024, there was less rainfall throughout the year. Also, the temperature was higher than in previous years. These combined effects of rainfall and temperature would explain the low number of *P. devastans* populations in 2024. But according to Bruneau De Miré (1970) and Decazy (1974), rainfall and temperature are not factors directly influencing variations in cocoa pest populations. However, according to Lavabre *et al.* (1963), good rainfall and temperature allow for good fruit set, which in turn promotes the population explosion of these pests.

CONCLUSION AND APPLICATION OF RESULTS

This study revealed that the Coreidae moth *P. devastans* is present in cocoa plantations in the Haut-Sassandra region. This pest was present in the region every year of the study. The average number of *P. devastans* per 12 cocoa trees ranged from 5.10 ± 0.17 to 6.35 ± 0.28 .

The study showed two periods of *P. devastans* population explosion in the Haut-Sassandra region. The first period extends from January to June, with a peak in March, and the second from July to December, with a peak in August.

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